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AUTHORITY

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SCP-1

TEST OF SPHERICAL MUNITIONS

DPGR 108

RW 2-52

15 May 1953

CONFIDENTIAL [redacted]

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(6) DYNAMIC TEST OF SPHERICAL RADIOLOGICAL MUNITIONS - DPG No. 2-52 (U) (8)

DUGWAY PROVING GROUND REPORT 108

(14) DPG-R-

Project Numbers 4-98-05-005 and 4-98-05-007

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CONTENTS

ABSTRACT

OBJECTIVES

The objectives of this test were (1) to assess the radiation fields produced by several E78R4 individual spherical munitions filled with radioactive agent when airburst at varying altitudes, and (2) to determine the effect of weathering on the ground contamination.

RESULTS

Six simulant-filled munitions and 16 agent-filled munitions were dropped between 21 and 27 May 1952.

No data were obtained from the simulant-filled munition because the litharge failed to form a cloud to indicate the opening altitudes of the munitions. Of the agent-filled munitions that were released, seven opened properly, six failed to open, and three could not be located.

Measurements were taken of the radiation fields produced by the properly functioned munitions.

No studies were made of the effect of weathering on pellet disintegration, as previous studies failed to show demonstrable changes.

CONCLUSIONS

The E78R4 munitions which opened at a height of 5000 feet covered larger areas at all intensity levels equal to or greater than 0.1 mr/hr, than those munitions which opened at 2000 feet.

Area coverage was not discernibly affected by variation in pellet size.

One sampling height was sufficient to detect differences in area coverages.

INTRODUCTION

AUTHORITY

This test was authorized by:

Letter, CMLRE-CR(T) 29 February 1952, subject: Request for Dugway Proving Ground Tests;

Test Directive, CMLRE-G, 10 March 1952, subject: Development Test, Spherical Radiological Munitions from the Aerial Pellet Disseminator, E78R3.

The test was conducted under Research and Development Project 4-98-05-007: Testing of RW Aerial Munitions, DPG; and Project 4-98-05-011: Testing of RW Materiel for Detection, Protection, and Decontamination, DPG.

OBJECTIVES

The objectives of this test were (1) to assess the radiation fields produced by several E78R4 individual spherical munitions filled with radioactive agent when airburst at varying altitudes, and (2) to determine the effect of weathering on the ground contamination.

MATERIALS AND METHODS

MATERIALS

Agent

The agent was composed of approximately 99 per cent tantalum dust and one per cent molybdenum sulfide. The mixture was compressed into cylindrical pellets prepared in three sizes: 1½ mm diameter by 1½ mm in height, 2 mm by 2 mm, and 3 mm by 3 mm. The pellets were irradiated in the reactor at the Oak Ridge National Laboratories for a time calculated to give an activation of approximately 20 curies per pound. One pound of pellets was used in each agent-filled munition.

Munitions

The E78R4 radiological bomb is an aluminum sphere, three inches in diameter. The exterior is fluted so that the sphere rotates as it falls through the air. At a specified rotational velocity, a centrifugal arming device activates a timing mechanism which in turn functions an electrical squib. This functioning causes the munitions to separate into two hemispheres, dispersing the agent. The munition weighs three pounds when filled with agent.

Twenty munitions were filled with litharge and agent, and six were filled with litharge and lead shot, to simulate agent. Nine of the agent-filled munitions contained 2 mm pellets, five, equal

amounts by volume of 1½ mm and 3 mm pellets, and six, equal amounts of 1½ mm, 2 mm, and 3 mm pellets. The litharge was used in each munition to form a cloud for detection of opening altitudes by theodolite operators. Each munition used in the test was numbered in order that a particular munition and its contents could be identified on the target area.

Grids

The munitions were released over Targets K and N, which were on desert terrain (Fig. 1); Target K was 1800 by 1800 yards and Target N, 2400 by 2400. These targets were staked at 50-yard intervals. The stakes were labeled with X and Y coordinates, the X coordinate increasing toward the east and the Y increasing toward the north. The stakes themselves represented only odd coordinate points; in the surveying procedure, the midpoints between stakes were estimated and assigned appropriate even numbers.

Field surveying was accomplished on areas marked off around the region in which the agent from individual munitions was dispersed. These areas included all intensities greater than 0.1 mr/hr. In several instances, these areas were within Targets K and N. In other instances, small grids were staked around the "hot" areas beyond the two targets. Natural obstacles prevented surveying in entirety Areas 3 and 5.

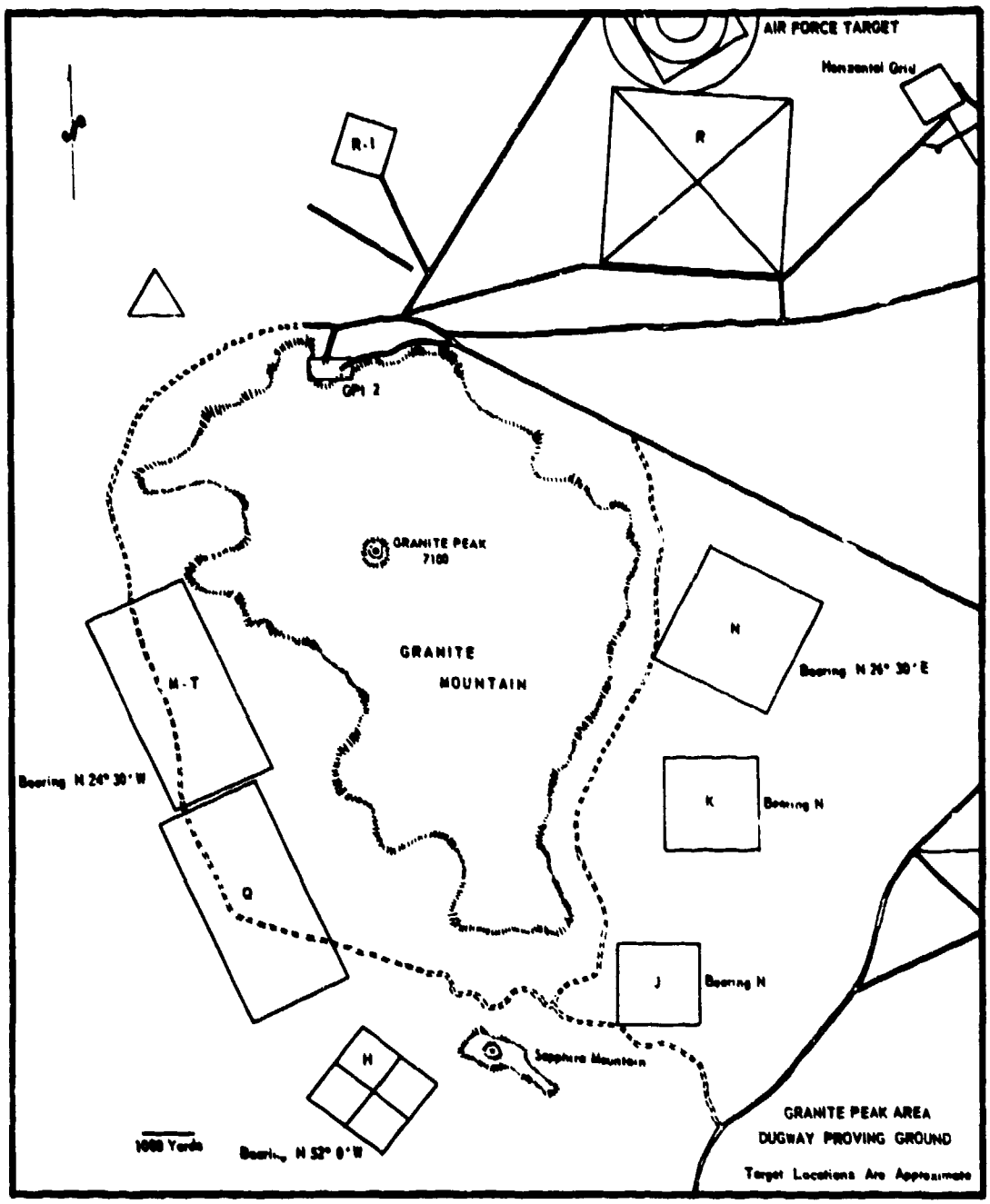

Fig. 1.

Smoke pots were used as aiming points on the targets. The grid complex, the coordinate systems for the small grids beyond Targets K and N, and the location of the smoke pots are shown in Figure 2.

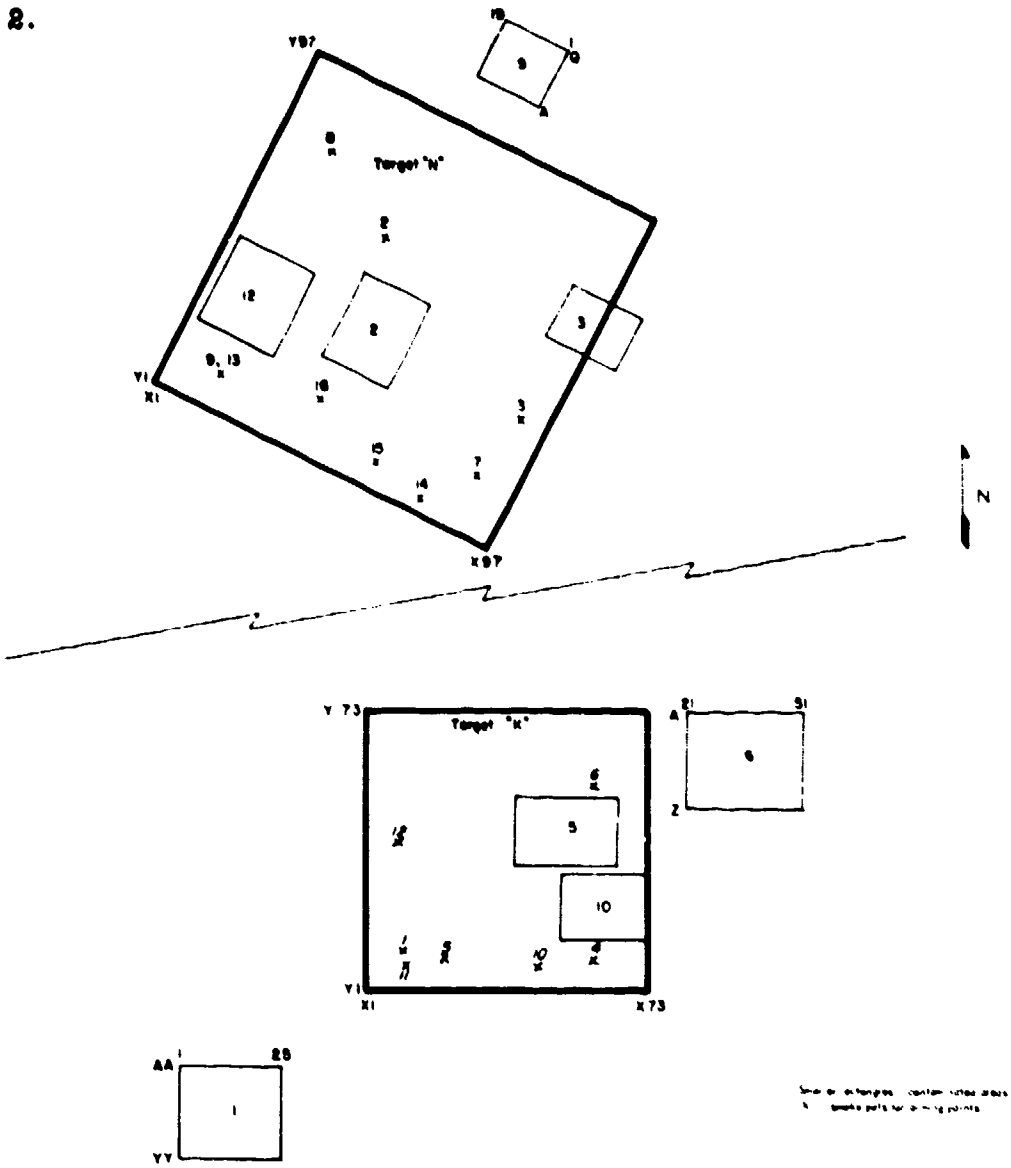

Fig. 2. – Target complex and areas contaminated by the E78R4.

Radiation-Measurement Equipment

MX-5 and T1-B radiation meters were used in the field. The MX-4 was employed in the RW slab area; in the laboratory, a Berkeley-2000 scaler was used in conjunction with a Nuclear geiger tube for measurement of pellet activity. A Gram-atic balance was used to weight the agent pellets.

Protective Equipment

At all times personnel wore film badges and dosimeters. RW protective clothing was worn whenever the possibility of direct contact with radioactive material existed.

METHODS

Munition Filling and Transporting

Munitions were loaded in the filling cell at the RW slab area. The filling operation is illustrated in Figure 3.

Groups of three agent-filled munitions were placed in numerical order into a dispenser. The dispenser was then loaded into the bomb bay of a B-50 (Figs. 4-5).

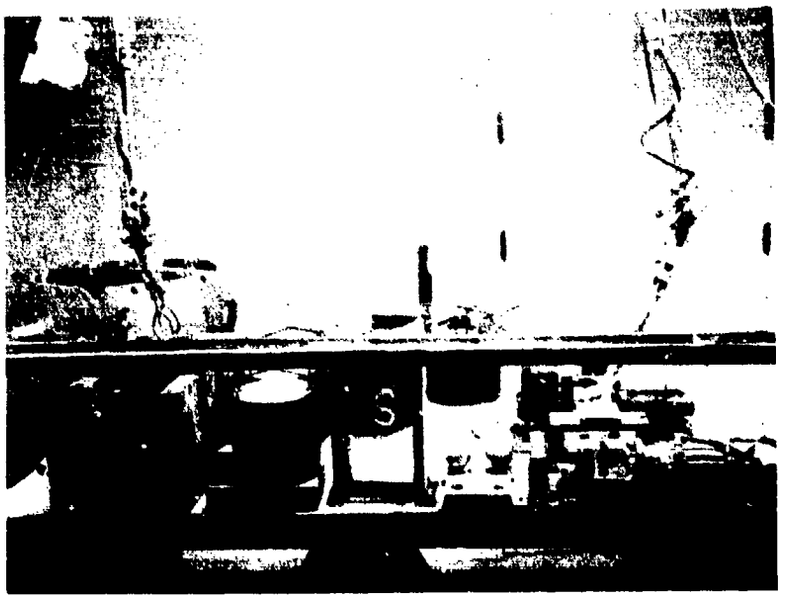

Fig. 3. – Filling Operation. A mechanical hand picks up the munition from a rack, places it in a hydraulic clamp (the dark object on the table in the foreground on the extreme right), and screws the pellet tube onto a short transparent plastic nipple that fits into the munition. The munition is then lifted onto a vibrator, which shakes the pellets from the tube. The filled munition is then placed again in the hydraulic clamp. The tube and the nipple are removed, and a cap is screwed into the opening of the munition.

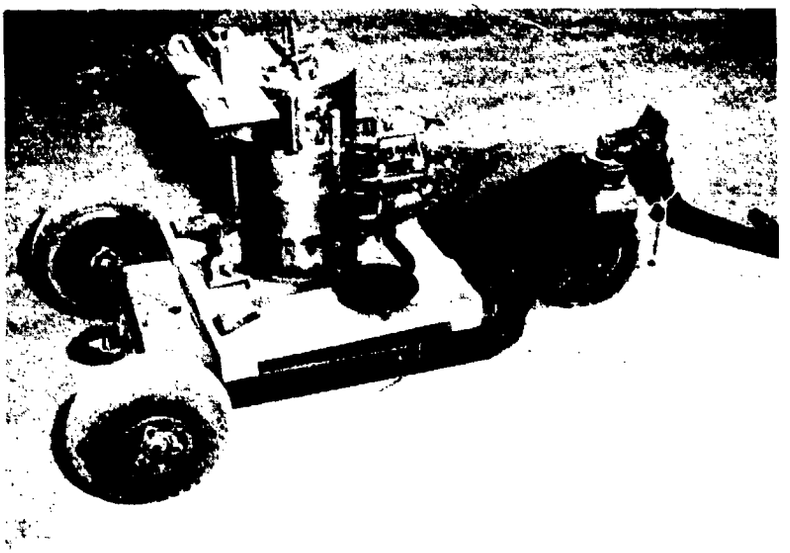

Fig. 4. – Munition dispenser

Fig. 5. – Munition dispenser mounted in bomb bay of the B-50.

Munition Activity Measurements

The activity in curies contained in each munition was determined by comparison of external radiation fields of the agent-filled munitions with the field of an identical sample munition of known activity (Table 1). The curie content of the sample munition, Munition 21, was calculated as the product of the pellet specific activity in curies per gram and the weight, 454 grams, of agent in the munition.

TABLE 1: Munition-radiation Measurements

MISSION NO.	SPHERE NO.	MX-4 READING AT 4 FT. (Roentgens/hr)	T-1B READING AT 4 FT. (Roentgens/hr)
1	1	11.4	10
	2	11.4	10
	3	6.8	8
2	4	9.2	10
	5	11.0	14
	6	10.2	14
3	7	11.0	14
	8	11.8	15
	9	12.2	15
4	10	11.6	12
	11	11.2	12
	12	11.8	10
5	13	11.8	10
	14	11.4	10
	15	12.1	10
	16	12.3	10
Spares	18	11.2	10
	19	10.6	9
	20	11.2	10
Sample	21	11.8	10

After the filling operations had been completed and measurements taken of the radiation fields of all the agent-filled munitions, Munition 21 was brought back to the filling cell. All pellets in the munition were emptied into a strainer to remove the litharge. The pellets were then placed into a lead pot and taken to the laboratory where 400, 2-mm pellets were removed and divided into 100 samples of four pellets each.

Each of these samples was counted, and the apparent activity in curies of the sample was calculated from previous calibration of the counting instruments (DPGR 107)[1]. Counting rates were corrected for coincidence loss, background, and for radioactive decay. Counting and weighing techniques are also described in DPGR 107.

The 95 per cent confidence limits for the apparent specific activity of the agent sampled from Munition 21 were 85.7 and 88.2 apparent millicuries per gram. From these values the total activity of the munition was calculated to be 38.9 to 40.0 apparent curies. The term "apparent curies" is used as no corrections were made for self absorption of the gamma rays in the material of the pellets used to calibrate the counter.

Data on munition radiation measurements (Table 1) are considered inconclusive for the purposes of calculation of individual munition activity. The meters used were not calibrated on the higher scales

[1] "Static Tests of Four Segments of Full-Diameter Sectional Munitions, E83; DPG RW 1-52," DPGR 107, 7 May 1953.

because no high-level calibration sources were available. Also, the meters were considered inaccurate because of the inconsistency in the readings of the two instruments. The low activity of Munitions 3 and 4 was caused by incomplete fill of these munitions.

Target Radiation Intensity Measurements

Standard radiation meters were used by ground personnel to locate contaminated areas. Location of these areas was facilitated by aerial survey at approximately 50 feet above terrain. A contaminated area was detected by simultaneous indications of high intensity by two MX-5 meters. Colored smoke grenades were dropped on these areas as markers for the ground crew. Each area located was assigned the number of the munition which contaminated it.

Following preliminary survey by the Health Physics personnel, radiation intensity measurements were made at heights of one, three, and six feet throughout the targets at 25-yard intervals. Measurements of area background had been completed before the test.

All the MX-5 meters used were calibrated on the 2 mr/hr and 20 mr/hr scales (DPGR 107); the 0.2 mr/hr scale could not be calibrated because of the background interference. Target intensity readings were corrected by the appropriate calibration curves. No corrections were made for normal target background (0.02 mr/hr), and no corrections were necessary for residual contamination.

RESULTS

Simulant-filled munitions were dropped on 21 May. The litharge in these munitions failed to form a cloud which could be observed when the munitions opened; thus, no data on opening altitudes were obtained from these drops.

Munitions, filled with agent and litharge, were released on the five missions described in Table 2. Two inaccessible areas on Granite Peak showing significant levels of activity were considered to have been contaminated by Munitions 7 and 13. An unidentified area of activity on Target N was assigned to Munition 12. The remaining areas of contamination were identified at the time of drop or by location of a hemisphere. None of the hemispheres located on the targets contained agent, but litharge was found in three (Table 2).

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TABLE 2: Munition-functioning Data

MISSION NO.	DATE	SPHERE NO.	TIME OF DROP	STATUS OF HEMISPHERES	
				First *	Second
1	23 May	1	0740	lost	lost
		2	0804	litharge	empty
		3	0824	lost	empty
2	24 May	4	0630	dud	---
		5	0653	litharge	lost
		6	0728	lost	lost
3	24 May	7	0906	lost	lost
		8	0924	dud	---
		9	0940	lost	empty
4	27 May	10	0608	caked litharge	lost
		11	0632	dud	---
		12	0654	lost	lost
5	27 May	13	0933	lost	lost
		14	0948	dud	---
		15	1005	dud	---
		16	1024	dud	---

* Hemisphere containing opening mechanism.

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Only three of the agent-filled munitions were sighted by the theodolite operators. These munitions were observed to open at the following heights:

Munition Number	Scheduled Opening Altitude	Observed Opening Altitude
3	2000	1800
9	2000	2360
6	5000	6035

No studies were made of the effect of weathering on pellet disintegration, because previous studies have failed to show demonstrable changes (DPGR 107).

Meteorological data are given in Appendix I.

Isointensity contours prepared from field measurements three feet above terrain are given in Appendix II. A comparison is made for contours drawn from readings taken at one and six-foot heights with those taken at three feet (Figs. 8b and 8c, Appendix II), and is representative of such comparisons on all the targets.

Area coverage at each isointensity level was determined by planimetery of the contours based on measurements taken at a height of three feet (Table 3). Data on munition number, opening altitude, and agent pellet size are arranged in order of decreasing area coverage in Table 4.

TABLE 3: Area Coverage in Thousands of Square Yards Determined by Contour Planimetry*.

Intensity mr/hr	Munition							
	1	2	3**	5	6	9	10	12
0.1	191.4	148.9	(110.9)	207.5	303.2	156.3	177.2	178.8
1	34.8	30.9	(27.8)	34.1	44.9	46.0	47.8	47.6
10	4.4	4.5	(2.6)	6.5	7.4	6.8	3.9	6.4
100	0.4	0	(0)	0	0	0.8	0	0

* Tabulated values indicate the area of the target at the listed intensity or greater. Readings were taken three feet above terrain.

** These values were not used in further comparisons of munitions.

TABLE 4: Munition Numbers arranged in Order of Decreasing Area Coverage for Various Radiation Intensity Levels.

0.1 Mr/hr			1 Mr/hr		
Munition	Scheduled Opening Altitude	No. of Pellet Sizes*	Munition	Scheduled Opening Altitude	No. of Pellet Sizes*
6	5000	1	9	2000	2
5	5000	1	10	2000	1
1	2000	3	12	5000	3
12	5000	3	6	5000	1
10	2000	1	1	2000	3
9	2000	2	5	5000	1
2	2000	1	2	2000	1

10 Mr/hr			100 Mr/hr		
Munition	Scheduled Opening Altitude	No. of Pellet Sizes*	Munition	Scheduled Opening Altitude	No. of Pellet Sizes*
6	5000	1	9	2000	2
9	2000	2	1	2000	3
5	5000	1			
12	5000	3			
2	2000	1			
1	2000	3			
10	2000	1			

* 1 size: 2 mm pellets. 2 sizes: 1½ mm and 3 mm pellets.
3 sizes: 1½ mm, 2mm and 3 mm pellets.

Target intensity data were also evaluated by counting the number of stations on each target showing intensities equal to or greater than given intensities (Table 5). This table is corrected for unreported stations; readings for these stations were estimated by interpolation. The intensity at each station was considered to represent an area of 625 square yards and graphs of area coverage versus intensity are given in Figure 6, for each scheduled opening altitude.

TABLE 5: Number of Stations Showing Intensities Greater than or Equal to Given Intensities at 1 ft., 3 ft., and 6 ft. Sampling Heights

NUMBER OF STATIONS								
Intensity (mr/hr)	Sampling Height (feet)	Scheduled Opening Altitude						
		2000 Feet				5000 Feet		
		Munition Number						
		1	2	9	10	5	6	12
0.1	1	341	225	265	286	333	504	332
	3	335	236	264	288	349	538	327
	6	382	256	276	303	384	572	344
0.2	1	220	159	199	202	222	312	206
	3	230	178	197	208	245	323	207
	6	265	191	216	220	269	401	225
0.5	1	111	87	106	109	113	155	142
	3	132	108	118	130	120	165	149
	6	157	130	126	137	134	195	158
1	1	58	44	67	71	76	75	75
	3	66	58	81	80	76	82	83
	6	80	71	96	89	81	95	95
2	1	34	30	43	43	40	44	52
	3	38	33	48	44	43	48	53
	6	41	39	57	54	49	52	55
5	1	16	14	21	26	21	29	26
	3	18	16	22	24	20	29	25
	6	19	16	25	19	23	22	24
10	1	11	7	12	12	15	19	16
	3	9	8	12	7	13	16	14
	6	9	11	13	9	12	12	11
20	1	6	4	6	5	6	14	9
	3	6	5	6	4	2	10	6
	6	6	5	6	5	2	9	6

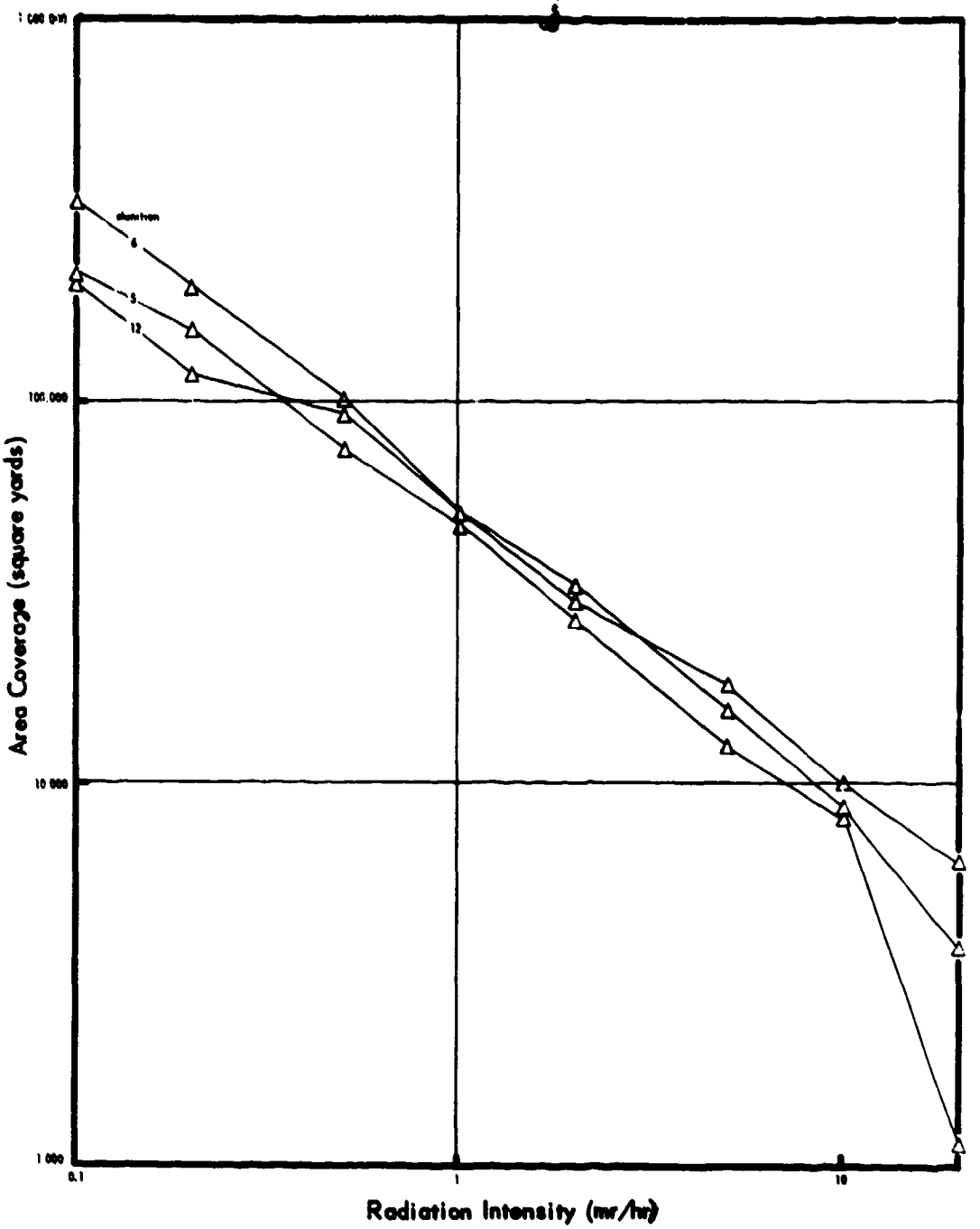

Fig. 6a – Area coverage versus target radiation intensity. Scheduled opening altitude – 5,000 feet.

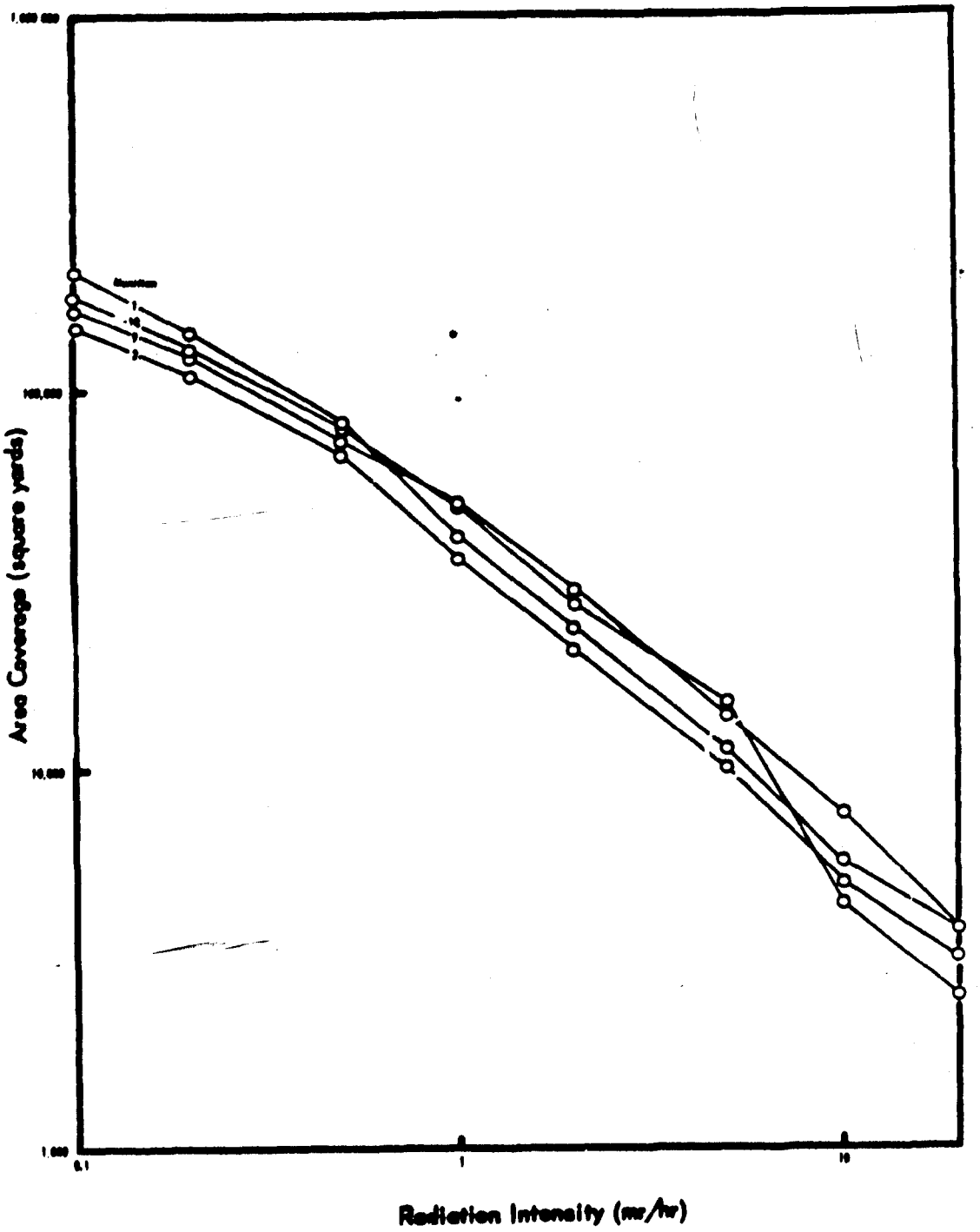

Fig. 6b – Area coverage versus target radiation intensity. Scheduled opening altitude – 2,000 feet.

DISCUSSION

In analysis of area coverage produced by the successfully functioned munitions, all munitions were considered to have the same quantity and specific activity of agent because no differentiation could be made from the data in Table 1. Munition 3 was omitted from all comparisons since it was incompletely filled. Scheduled opening altitudes were used because actual opening altitudes were determined for only three of the munitions. The lith-arge used in this test is considered ineffective as an opening-altitude indicator.

A statistical analysis was made of the data in Table 5 to determine the effects on munition area coverage of variations in opening altitude, agent pellet size, and in height of target radiation measurements. This analysis was made by the method described in Appendix III (Analysis of Variance Procedures).

There was a significant difference in area coverage (at the 99 per cent probability level) between munitions scheduled to open at a height of 5000 feet and those scheduled to open at 2000 feet (Fig. 6). This difference was significant at each isointensity level and at all sampling heights.

An average of area coverage for the four munitions opened at 2000 feet and the three, at 5000 feet was used to plot the curves

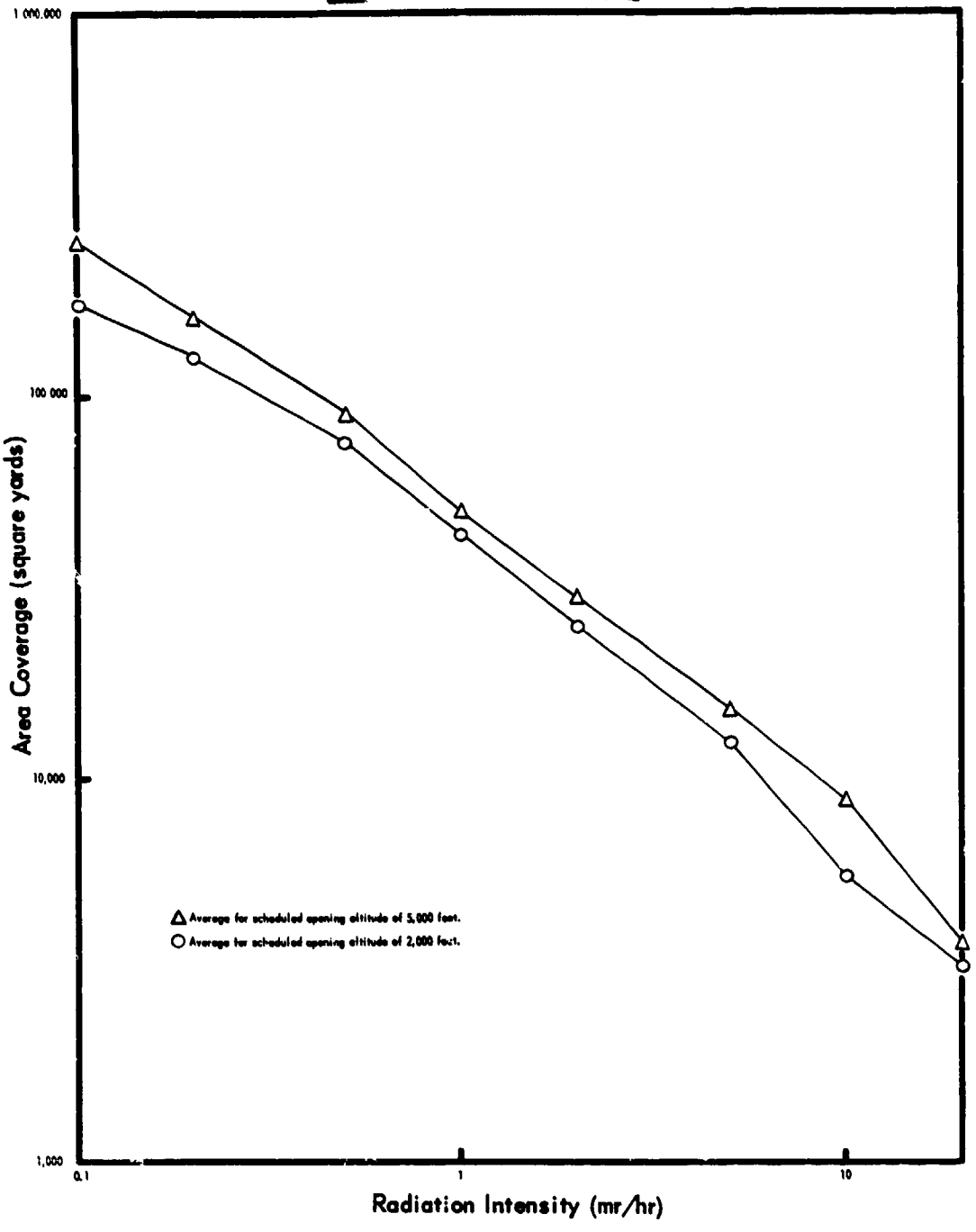

Fig. 7. – Average area coverage versus target radiation intensity.

in Figure 7. This figure shows that munitions which opened at a height of 5000 feet covered larger areas at all intensity levels equal to or greater than 0.1 mr/hr than those munitions which opened at 2000 feet.

Analysis of the effect of pellet size on area coverage was inconclusive. The data in Table 4 also failed to show any trend in the variations of area coverage with variations in pellet sizes. There were no significant differences (at the 99 per cent probability level) in area coverage at the three heights employed for measurement of target radiation at intensities above the five mr/hr level. Below this level, more intensity readings were recorded above a given intensity level at the six-foot height, than at any other.

CONCLUSIONS

The E78R4 munitions which opened at a height of 5000 feet covered larger areas at all intensity levels equal to or greater than 0.1 mr/hr, than those munitions which opened at 2000 feet.

Area coverage was not discernibly affected by variation in pellet size.

One sampling height was sufficient to detect differences in area coverages.

APPENDIX I

METEOROLOGICAL DATA

TABLE 1: Winds Aloft

HEIGHT (Feet)	23 May 0512-0532 (°)	(mph)	24 May 0507-0527 (°)	(mph)	24 May 0800-0820 (°)	(mph)	27 May 0520-0540 (°)	(mph)
1000	347	8.3	158	2.4	205	6.7	133	3.0
2000	028	16.5	128	5.6	190	5.1	072	4.8
3000	037	21.0	123	9.0	158	7.0	078	3.5
4000	040	21.0	075	10.8	140	8.0	017	7.5
5000	014	19.2	062	9.4	112	8.0	011	6.5
6000	360	24.0	014	4.4	100	4.0	344	10.5
7000	002	26.8	000	6.8	005	4.1	325	15.5
8000	010	20.6	315	9.8	333	12.0	310	21.0
9000	015	21.1	320	5.0	330	8.8	315	24.0
10,000	012	22.0	000	5.2	320	4.2	320	24.9
11,000	012	23.2	015	5.8	293	4.0	320	27.8
12,000	---	---	027	6.6	085	5.8	320	27.5

TABLE 2: Wiresonde Data

24 MAY			27 MAY		
TIME (MST)	ALTITUDE (Feet)	TEMPERATURE (°F)	TIME (MST)	ALTITUDE (Feet)	TEMPERATURE (°F)
0600	0	45.3	0638	0	51.2
0601	4	45.3	0639	4	50.6
0602	10	46.3	0641	10	50.4
0603	25	46.0	0642	25	50.4
0604	50	46.3	0644	50	50.8
0605	71	46.9	0645	75	50.1
0606	134	51.8	0646	100	50.8
0607	189	57.0	0647	148	52.5
0608	245	59.0	0648	200	52.8
0609	292	60.2	0649	250	55.4
0610	346	60.9	0650	300	55.0
0611	388	60.9	0651	350	55.2
0612	462	61.1	0652	400	56.2
0613	578	61.1	0700	499	57.5
0614	692	61.5	0702	599	7.5
0615	725	61.5			
0750	0	62.2	0855	998	71.6
0751	4	61.9	0856	900	67.0
0752	10	59.0	0857	800	69.2
0753	25	58.7	0858	700	68.2
0754	47	58.3	0859	600	67.0
0755	75	58.1	0900	499	64.2
0756	94	58.8	0901	400	64.0
0757	140	58.3	0903	300	64.0
0758	187	58.1	0910	200	73.8
0759	234	58.8	0912	150	72.0
0800	280	60.0	0913	100	71.2
0801	316	60.2	0914	75	71.4
0802	371	61.1	0915	50	70.3
0803	456	61.5	0916	25	70.5
0804	531	61.3	0916	10	69.5
0805	594	60.4	0917	4	70.5
0806	670	60.9	0918	0	72.5
0807	736	60.2			
0808	786	60.4			

TABLE 3: Rawindsonde Data

PRESSURE (MB)	ALTITUDE (Feet)	TEMPERATURE (°F)	DEW POINT (°F)	WIND DIRECTION (Degree)	WIND SPEED (mph)
23 May					
870	0	55	39	Calm	Calm
850	5,000	52	37	Calm	Calm
806		46	32		
790		46	32		
700	10,220	32	25	020	12
600		18	10		
576		16	0		
538		12	-17		
500	18,760	5	---	030	7
27 May					
872	0	59	34	200	1
850	5,070	57	28	180	4
700	10,340	37	3	070	7
680		34	1	---	---
670		25	---	---	---
500	19,000	9	---	320	17
496		9	-20	---	---
420		-13	-27	---	---
400	24,410	-17	-35	320	21

APPENDIX II

CONTOURS FOR VARIOUS
ISOINTENSITY LEVELS

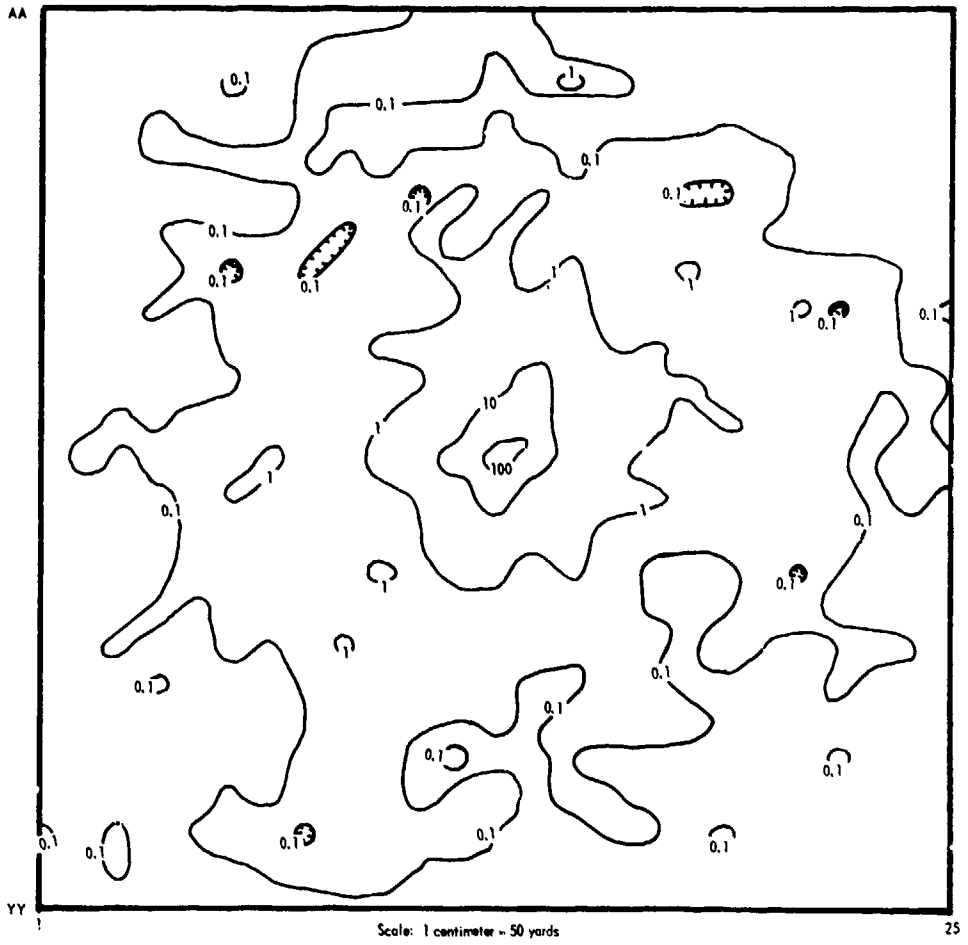

Fig. 1. – Isointensity contours at the three-foot level showing gamma radiation in milliroentgens per hour for Munition 1.

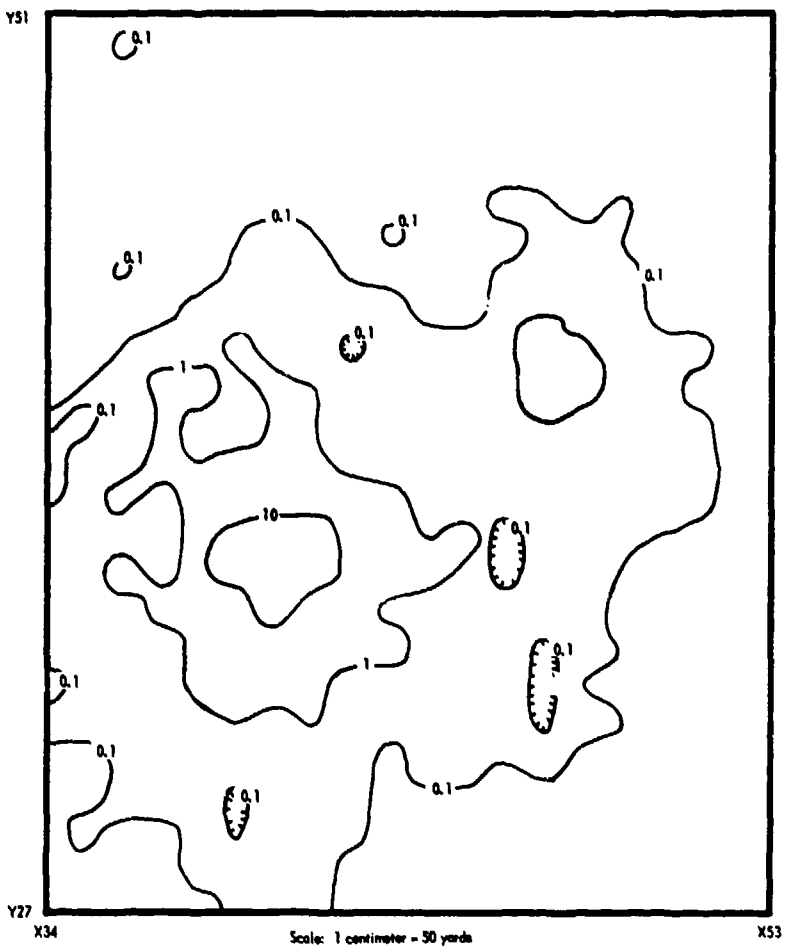

Fig. 2. – Isointensity contours at the three-foot level showing gamma radiation in milliroentgens per hour for Munition 2.

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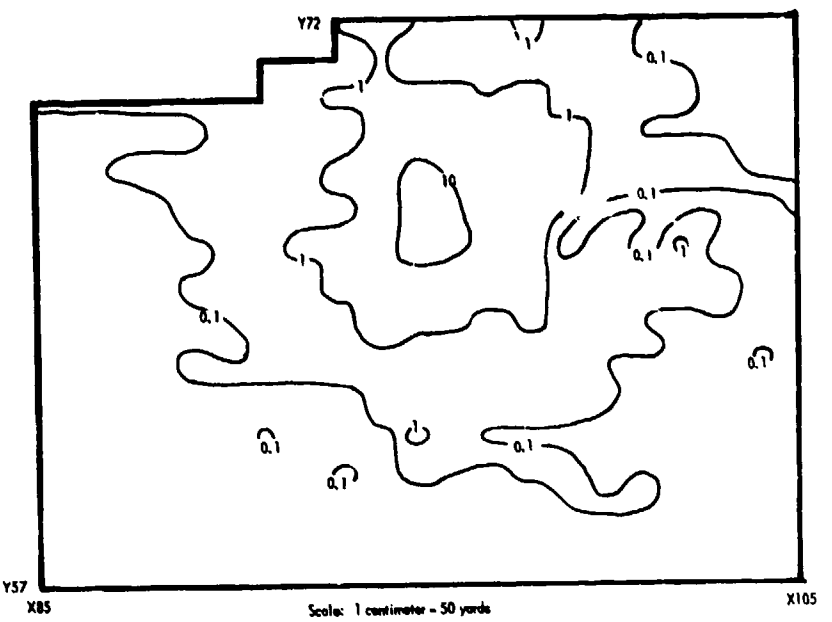

Fig. 3. – Isointensity contours at the three-foot level showing gamma radiation in milliroentgens per hour for Munition 3.

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[redacted]

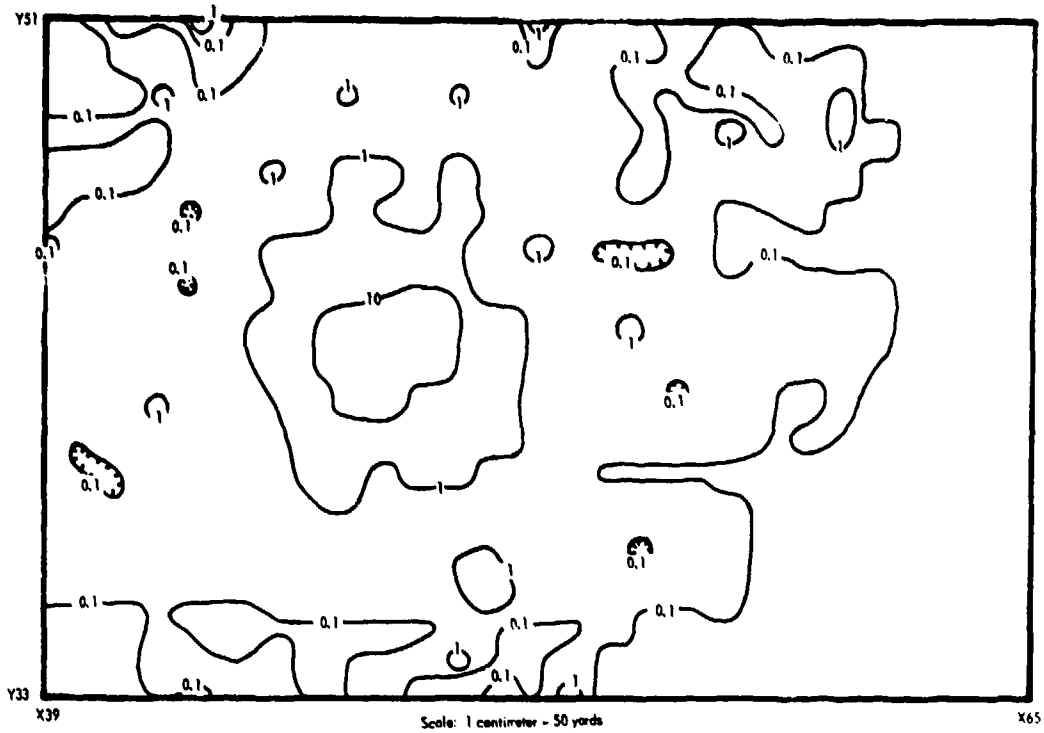

Fig. 4. – Isointensity contours at the three-foot level showing gamma radiation in milliroentgens per hour for Munition 5.

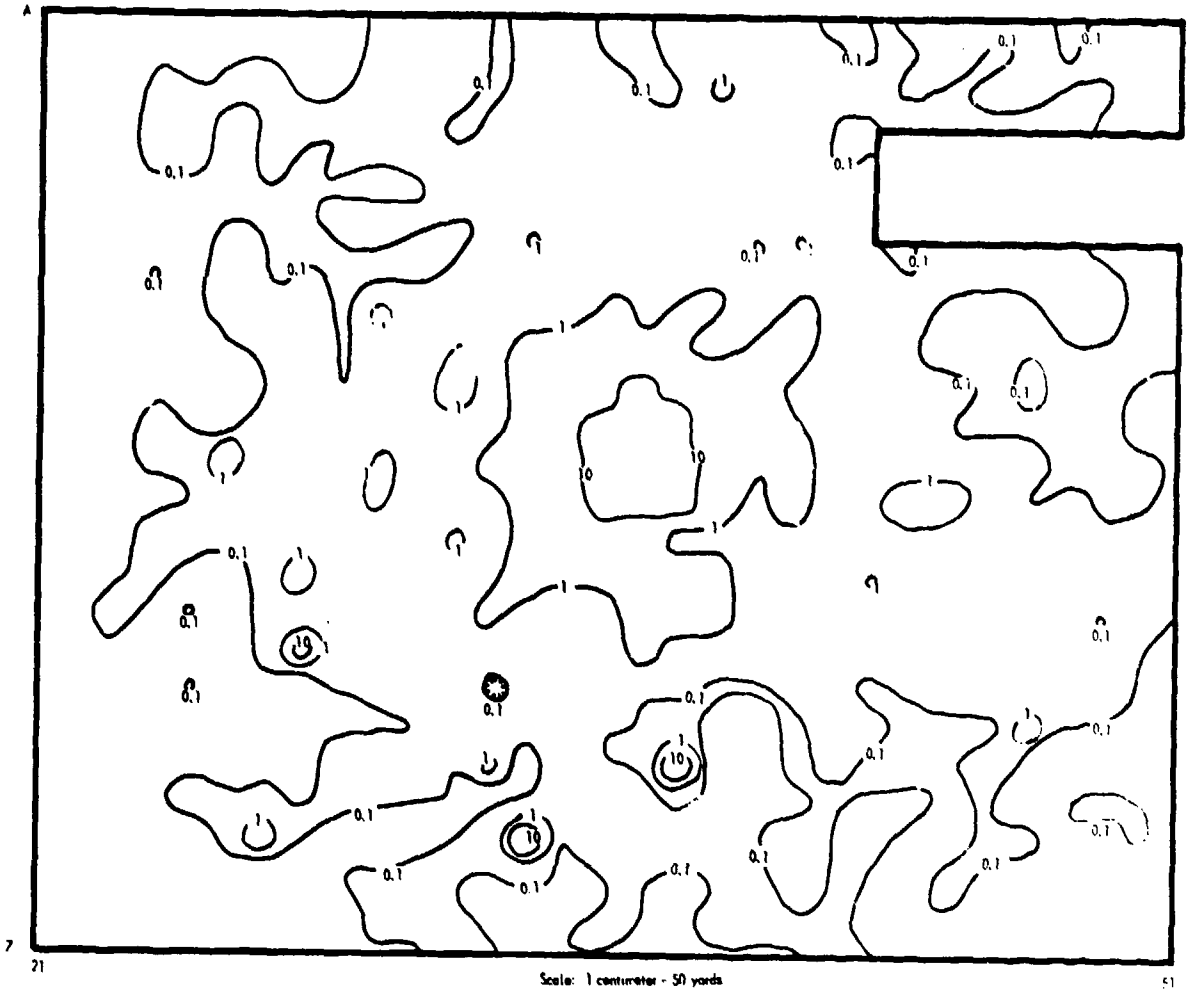

Fig. 5. – Isointensity contours at the three-foot level showing gamma radiation in milliroentgens per hour for Munition 6.

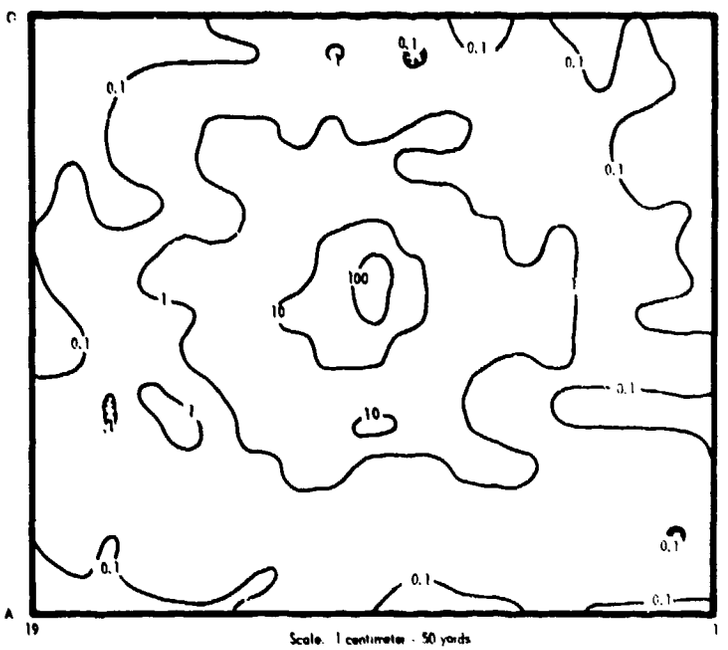

Fig. 6. – Isointensity contours at the three-foot level showing gamma radiation in milliroentgens per hour for Munition 9.

[redacted]

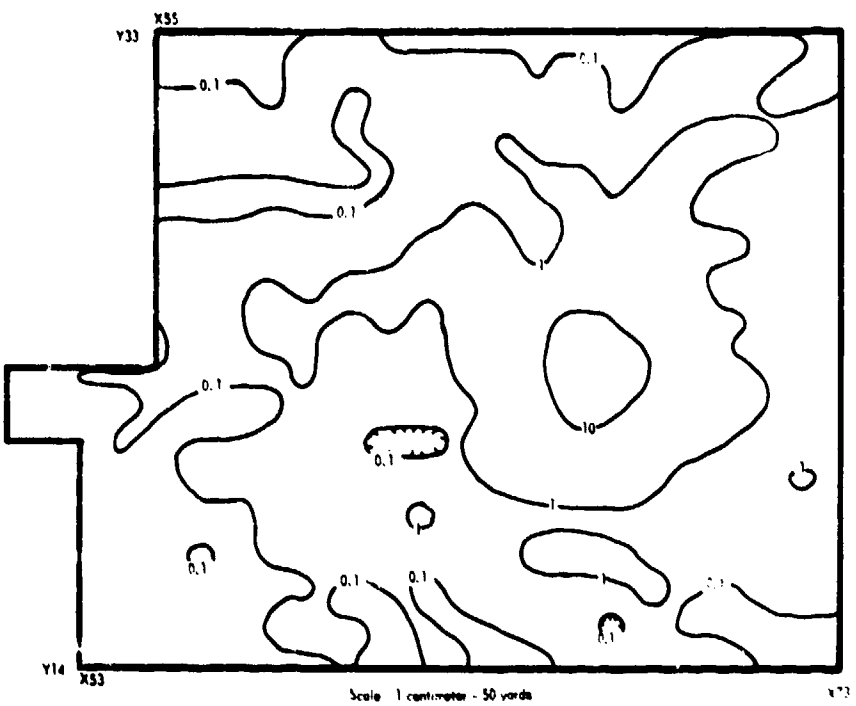

Fig. 7. – Isointensity contours at the three-foot level showing gamma radiation in milliroentgens per hour for Munition 10.

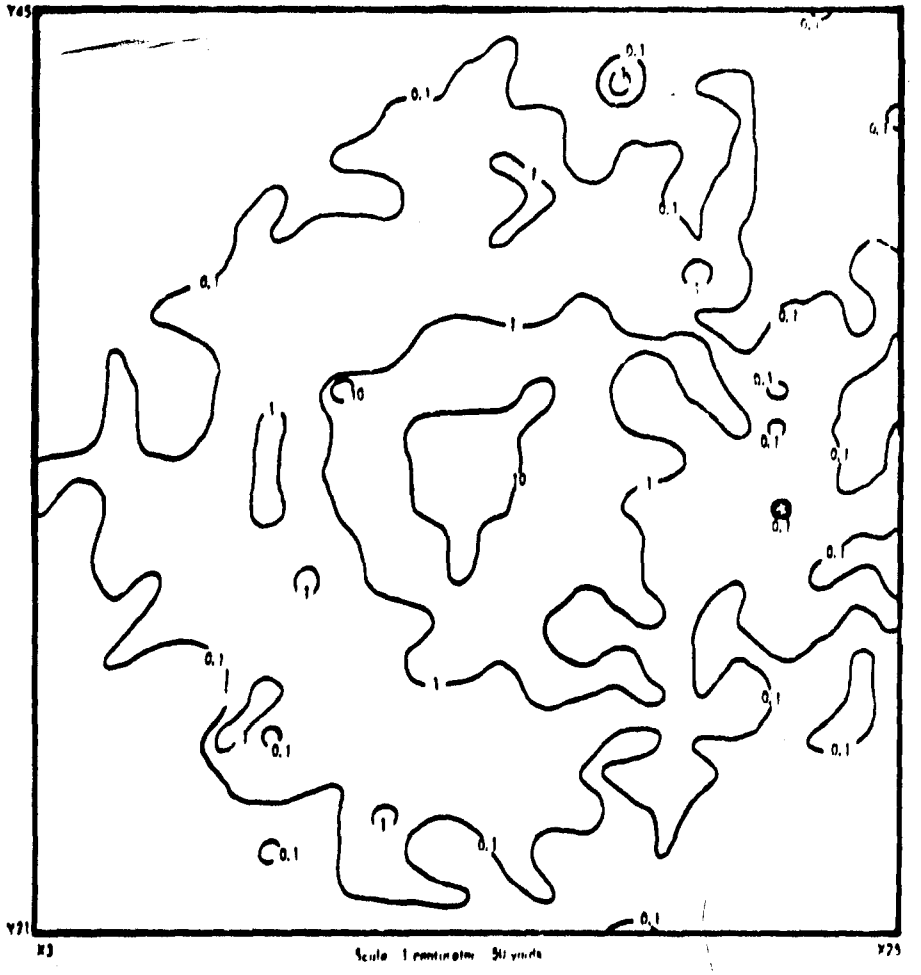

Fig. 8a. – Isointensity contours at the three-foot level showing gamma radiation in milliroentgens per hour for Munition 12.

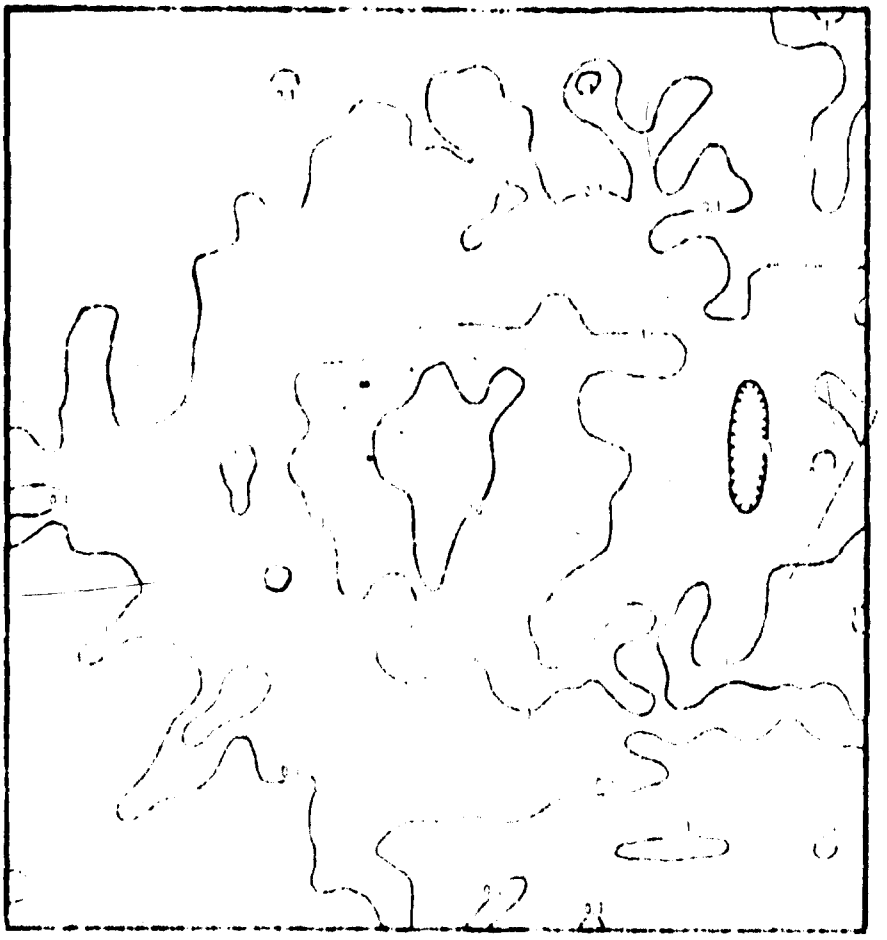

Fig. 8b. -- Isointensity contours at the one-foot level showing gamma radiation in milliroentgens per hour for Munition 12.

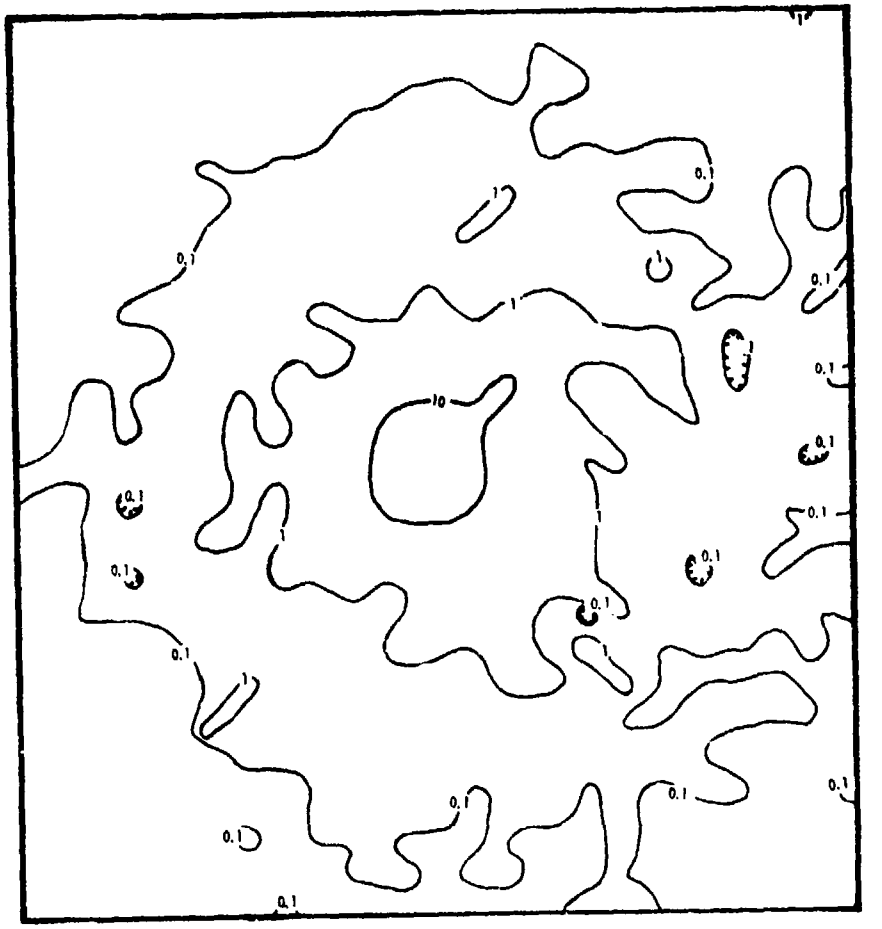

Fig. 8c. – Isointensity contours at the six-foot level showing gamma radiation in milliroentgens per hour for Munition 12.

APPENDIX III

ANALYSIS OF VARIANCE PROCEDURES

ANALYSIS OF VARIANCE PROCEDURES

Analysis of variance techniques were applied to the data in Table 5, page 22. The different intensity levels were treated independently; one analysis of variance was run for the data in the first three rows of the table (0.1 mr/hr intensity level), a second for the second three rows, and so forth. This procedure was utilized in order to determine whether or not a significant difference would be found between sampling heights at each intensity level.

The following example will explain the calculations. Data from Table 5, page 22, (0.1 mr/hr intensity level) are treated as shown in Table 1, and then compiled as shown in Table 2. Necessary assumptions and details of this technique are found in statistical texts; Table 2 is similar to Table 3.3, Cochran and Cox[1].

TABLE 1: Number of Stations Showing Intensities Greater Than or Equal to 0.1 mr/hr at 1 ft., 3 ft., and 6 ft. Sampling Heights

NUMBER OF STATIONS										
Sampling Height (feet)	Scheduled Opening Altitude									Grand Total
	2000 Feet					5000 Feet				
	Munition Number					Munition Number				
	1	2	9	10	Total	5	6	12	Total	
1	341	225	265	286	1117	333	504	332	1169	2286
3	335	236	264	288	1123	349	538	327	1214	2337
6	382	256	276	303	1217	384	572	344	1300	2517
Total	1058	717	805	877	3457	1066	1614	1003	3683	7140

[1] Experimental Designs, Cochran, William G., and Cox, Gertrude M., John Wiley & Sons, Inc., 1950, p. 51.

From these data Table 2 is computed.

TABLE 2: Analysis of Variance of the Data in Table 1, page 53.

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F-RATIO*
Sampling Heights	2	4,208	2,104	15.03
Theoretical Opening Altitude	1	75,469	75,469	539.06
Munitions	5	96,254	19,251	137.51
Residual Error	12	1,681	140	
Total	20	177,612		

* (Mean square)/(Mean square of residual error).

If the "F-Ratio" is near one, the "source of variation" listed has no effect on the number of stations reporting. A slight difference from one might be caused by chance variations and so must be disregarded as a criterion of significance. To eliminate this problem, a significance level is arbitrarily set (in this case 99 per cent). The requirement for significance was as follows: for an F-Ratio to be significantly different from one, that ratio must be greater than a value r, where r is a number such that, if the "source of variation" listed has no real effect on the data, the statistical procedure used would obtain an F-Ratio less than r 99 out of 100 times. For establishing the significance of sampling height in this test, the F-Ratio had to be greater than 6.93, while for the significance of the difference between opening heights, it had to be over 9.33. Table 3 lists the actual F-Ratios obtained for each of the intensity levels at which an analysis was conducted. Underlined values are considered significant.

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TABLE 3: F-Ratios Obtained from Analysis of Variance of Data in Table 5, page 22.

SOURCE OF VARIATION	INTENSITY LEVEL (mr/hr)								99% S.R.*
	0.1	0.2	0.5	1	2	5	10	20	
Sampling Heights	15.03	12.85	35.11	45.20	36.67	0.23	2.38	3.6	6.93
Theoretical Opening Altitude	539.06	88.53	80.16	34.18	57.07	17.23	22.75	9.6	9.33

* 99% Significance Ratio

The following personnel are responsible for this report on RW testing:

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JUN 30 2000

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Dear Sir:

The Department of Defense (DoD) Radiation Experiments Command Center (RECC) was established in response to the direction of the 7 January 1994 Secretary of Defense memorandum to compile, review, catalog, and retain documents and information pertaining human subject experiments involving ionizing radiation. DoD RECC made documents and information available to the public after proper reviews for classifications, personal privacy, or other release restrictions. The RECC is the approving authority for the release of documents and information once the redacted material has been extracted.

The documents in the following list have been reviewed and are now approved for release to the public, i.e. DoD Distribution Statement A:

AD 161955: A Study of the Effects of Total and Partial Body Radiation on Iron Metabolism and Hematopoiesis

AD 202550: Study of the Post-Irradiation Syndrome in Humans

AD 332449: Preparation of O-Alkyl Alkylphosphonoazidothioates of the Type MEP (S) or N3

AD B969511: Preparation of 4-Benzylpyridine

AD 114826: Preparation of V Agents in Aqueous Medium

AD 521703: RW Decontamination and Land Reclamation Studies

AD 596085: Static Test of Full-Diameter Sectional Munitions, E83, DPG RW 1-53

AD 521702: Dynamic Test of Spherical Radiological Munitions

AD 521701: Static Test of Four Segments of Full-Diameter Sectional Munitions, E83

This information is provided to you so that you can update your records. If you have any questions, please call me at (703) 325-2407.

Sincerely,

D. M. Schaeffer
Program Manager
Radiation Experiments Command Center